

EDITORIAL ARTICLES.

MACEWEN ON THE CURE OF ANEURISM BY INDUCING THE FORMATION OF WHITE THROMBI WITHIN THE SAC.¹

In an address delivered before the Midland Medical Society, Dr. Macewen remarks upon the methods of curing aneurism by acting directly upon the blood stream to bring about coagulation. Most investigators who have endeavored to effect direct occlusion of an aneurism by the introduction of foreign bodies into its sac, have aimed at producing such an effect upon the blood stream as to cause coagulation of the blood contained in the sac, and the formation of a red thrombus. Galvano-puncture, stuffing the sac with wire, horsehair or catgut, and acu-puncture have all been used at times successfully, although most of the cases have been unsuccessful.

A red thrombus, Dr. Macewen remarks, consists at an early stage of masses of fibrin enclosing red corpuscles and a few white ones, the whole saturated with serum. As the fibrin contracts this serum is exuded and the mass diminished in bulk, and although it may have filled the sac at first, it now ceases to do so, and the blood stream may be re-established, especially in aneurisms with non-collapsible wall. This has happened in many instances where occlusion lasted some hours or even days, after which slight pulsation returned, the volume of blood passing through the aneurism ultimately becoming as great as before the formation of the red thrombus; shrinking continues in red thrombus for a considerable period, so that this result may occur several weeks after the apparent occlusion. After occlusion has occurred, the red thrombus, which is simply a mass devoid of vitality, undergoes one of several changes. (1) It may be acted upon in the same way as if

¹An Address on Aneurysm. By WILLIAM MACEWEN, M.D., of Glasgow, *British Medical Journal*, Nov. 15 and 22, 1890.

it were in a wound, leukocytes penetrating it, by which the thrombus is absorbed and replaced by fibrous tissue. This would be the most favorable termination for red thrombi within an aneurism, but it is seldom seen. (2) It may undergo red or yellow softening. The former is serious, not only from the conversion of the mass into reddish or grayish disintegrating pulp, but from the fact that some of this disintegrating material may find its way into the blood current and set up emboli; yellow softening is even worse, as there is here not a mere disintegration of the clot, but an intense inflammation of the walls of the vessel, ending in pus production, dependent, in all probability, on septic contamination. The wall of the vessel participates in the softening process, when the blood may burst into the surrounding tissues. The blood current may also carry portions of septic detritus into the circulation, causing septic infarctions; this form of softening may be guarded against by preventing septic matter being introduced from without, and by rendering aseptic, prior to operation on the aneurism, any sore, abscess or suppurating ear the patient may have. White thrombi are not liable to either of these forms of softening; the first could scarcely occur in them, while the second is preventable.

Pathological examinations at periods subsequent to partial or complete cure have shown that the sac, in the majority of these cases, contained white thrombi. Dr. Macewen rejects the commonly received opinion that these resulted from the organization of red thrombi, believing that in many cases the white thrombi were originally formed as such, although this circumstance was accidental, and not caused by the operator, nor from any effect upon the blood stream.

When the current of blood is unobstructed, white thrombi are prone to form in the interior of a vessel at a spot where irritation has been induced, and from which the endothelium has been removed. At such a point leukocytes, derived partly from the vessel wall, and mainly by segregation from the blood stream, become firmly adherent to the vessel. When this process has been initiated, it tends to grow by superimposed accretions, so that a partial thrombosis may proceed until complete occlusion occurs. The leukocytes, shortly after their deposition, disintegrate into a finely granular fibrin, which shrinks, but by

no means so greatly as does that of red thrombi. When the shrinking is complete, the white thrombus chiefly consists of an inert body, capable of, and subject to, further transformation.

The white thrombus is rapidly replaced by vascularized fibrous tissue, the granular fibrin originally deposited becoming absorbed and taking no share in the new formation. The first step in the process is the infiltration of the vessel wall with the leucocytes derived from the *vasa vasorum* and neighboring vessels. These penetrate the thrombus, becoming converted into formative cells which develop into fibrous tissue abundantly supplied with blood vessels. In this way a thoroughly vascularized connective tissue blended with the vessel wall is formed throughout. The vessels of this newly formed fibrous tissue are continuous with those of the *vasa vasorum*.

The deposition of white thrombi occurs so slowly that in large aneurismal sacs it is, as a rule, many months before occlusion takes place. The thinner the layers of white thrombi formed on the walls of the vessels the more easily will its organization be effected; therefore, the slower the process—other things being equal—the more surely will organization follow in its wake.

It is evident, then, that a thrombus formed by acting on the contents of an aneurismal sac is different from one induced by acting on its walls. The introduction of foreign bodies into the sac of an aneurism in which the blood is freely circulating, with the object of forming red thrombi, is not the most certain way of producing permanent occlusion of the vessel. White thrombi are more suitable for permanent aneurismal occlusion under such circumstances.

A white thrombus may be secured in an aneurismal sac by irritating the wall of the aneurism in such a way as to induce infiltration of the parietes with leukocytes and a segregation of them from the blood stream at the point of irritation. The irritation ought to be just sufficient to set up reparative exudation, and should not exceed it; if the irritation be pushed to such an extent as to induce softening of the vessel wall, not only would the object be frustrated, but the pressure of blood from within might cause the aneurism to burst.

While a white thrombus developed at a single irritated point in the

wall of a vessel might develop sufficiently to occlude it, it is better to provide many foci of thrombi. This may be done either by producing a uniform irritation over the whole inner surface, or by stimulating as many points as possible. It is also desirable to secure foci all over the sac, because if a white thrombus were formed in one part of the sac alone, it might be possible for the blood to be exerted all the more on some other part of the sac not so protected, which might result very seriously in case of a very thin wall. For this reason, also, it is desirable, as far as possible, to ascertain the form and dimensions of the sac before inducing plastic inflammation at any point in it. While this can readily be done from without in aneurisms of the extremities, in many cases situated in the trunk and root of the neck, the form can only be ascertained by investigation within the sac itself. Happily, the very instrument which is used in the treatment is excellently adapted to furnish this very information.

The instrument employed is a pin of sufficient length to completely transfix the aneurism and to permit of manipulation within it. Its calibre ought to be as fine as possible, the strength being only sufficient to penetrate the coat of the aneurism and the intervening tissues. It is cylindrical, tapers to a point like an ordinary sewing needle, and has on the opposite end a somewhat rounded head. As the coats of aneurismal sacs vary in thickness, it is necessary for the pins to vary in calibre, since those which may pass readily through the walls of one sac may not penetrate the thicker walls of another. They should also be finely polished, not only to facilitate their introduction, but to assist in rendering them aseptic.

The operation is preceded by careful cleansing and asepsis of the skin over the aneurism. The aseptic pin is then made to penetrate the sac, and pass through its cavity until it comes in contact with the opposite side, and no farther. Then irritation may be effected, either by moving the pin over the surface of the inner wall, or by allowing the impulse of the blood-current playing on the very thin pin to produce the same result. If the wall, penetrated by the pin, on introduction be dense, the former method will be preferable, as the force of the blood current will produce so feeble an action on the thin pin as to be

insufficient to move it to and fro, while it is firmly grasped by a dense wall. After acting thus for ten minutes at one part, the point of the pin, without being removed from the sac, ought to be shifted to another spot, and so on, until the greater portion of the internal surface opposite to the point of entrance has been acted upon. This should be done in a methodical manner. A single insertion of the pin through the aneurismal sac into its interior may be sufficient to enable the point of the instrument to come into contact with the greater part of its internal surface, but in some cases puncture from various sides of the external wall may be necessary to reach portions of the tumor which can not be attacked from the first puncture. While the pin is in the aneurism the protruding portion is surrounded by a bit of aseptic gauze, dry, or moistened with an aseptic solution. When it is withdrawn from the aneurism, the part is covered with a moist antiseptic dressing; for this purpose Dr. Macewen prefers a watery solution of carbolic acid, and he keeps this dressing in place for several days.

It is questionable whether all the necessary advantages derivable from irritation of the sac wall could not be obtained by keeping the pin within the sac but a few hours. Yet its retention for twenty-four or thirty-six hours serves to produce a greater immediate effect; there is certainly danger in retaining it for more than forty-eight hours.

In case of a very large aneurism, several pins may be introduced from various points, always allowing a considerable interval to exist between them, otherwise there might be too much damage to the vessel wall at one point. When the pin has been withdrawn, though there may be a little thickening of the tissues in the neighborhood, there will be either little or no diminution of the eccentric impulse. Occasionally it may be weeks before any distinct and tangible thickening of the coats can be observed; in other cases it may be discernable at a much earlier period, and, as a rule, distinct thickening of the coats is recognizable at an early period. It should also be remembered, especially in deep-seated aneurisms, that the thickening appreciable on the external surface of the sac through which the pin is passed, is much less, as a rule, than that on the part of the sac acted upon by the point of the pin, and, therefore, the one farthest away from the point of entrance which is accessible to manipulation.

In some cases Dr. Macewen has repeated the irritation many times, at intervals of weeks, with a view to hastening the cure. And while there was apparent advantage after each, it is doubtful whether the formation of thrombi, once fairly started, was not going slowly on, independent of this secondary interference. It is clear that the coats of the aneurism can not be reached by the pin after they have been covered by a thick layer of white thrombi. The extremity of the pin must come in contact then with the dead thrombi alone. Were the previous layers of thrombus vascularized, then the secondary introduction of the pin would be of service in coming in contact with living tissue, and setting up in it fresh irritation and fresh deposition of white thrombi.

In connection with the subject Dr. Macewen remarks that any method which would induce the occlusion of the sac by the formation of white thrombi and its consequent organization into living tissues, might be used, provided it evinced any superiority to this one. Such a one in particular would be a method which, while equally successful and easily applied, would do away with the necessity of opening the sac.

Four cases are detailed, in two of which the clinical results were verified by a subsequent pathological examination.

1. The first was a case of thoracic aortic aneurism seen at an advanced period when threatened by dyspnoea. The tumor distinctly pressed the trachea to the left and somewhat overlapped and flattened it. In this case treatment by ligature was contra-indicated on account of the danger of anaesthesia with a displaced and flattened trachea, while relief of the dyspnoea by tracheotomy would have been dangerous in the extreme, on account of the developing aneurismal sac. Pins were, therefore, inserted on seven occasions, with a few days' interval between each. On several, the pin was placed in such a position that its point barely touched the internal wall, while it was left free to move to and fro by the influence of the blood; in this way a slight scratching of the wall resulted. Several times the pins were retained in the sac for twenty-four hours, and once for forty-eight hours. Considerable consolidation followed, and a speedy favorable result was anticipated,

but death from the dyspnoea unfortunately occurred a month later.

The autopsy showed that two thirds of the interior of the aneurism had been filled with a white, firm, laminated thrombus, which was greatest along the inside of the outer wall, along which the needles played; much thinner on the inner wall, through which the needles were merely inserted in order to gain the interior of the sac; and thinnest of all in a small cavity at the upper portion of the aneurism which extended behind the trachea, and to which no needle had been directed, as it was not known to exist during life. It was evident that had the deposition continued at the same rate, complete occlusion would have occurred within a few weeks. Moreover, the walls of the aneurism had become so thickened that tracheotomy might have been performed with entire safety and death prevented, had the condition been known.

2. The second case was an aneurism of the upper part of the right femoral, involving the external iliac, and measuring five inches in diameter. The aneurism was somewhat circular in form, and its anterior wall was very thin, at one point only the skin and a very thin sac appearing to intervene between the examining finger and the circulating blood. Treatment by ligature was contra-indicated by extensive arterial degeneration, and pressure was shown, by prolonged trial, to be useless.

After pressure had been applied to the common iliac artery until the pulsations in the sac had entirely ceased, a long steel pin was passed into the sac until it touched the internal surface of the opposite side. It was left in that position for ten minutes, when the pin was withdrawn somewhat and then directed to another part inside the sac, when, after the same interval, it was again shifted to another position. Twelve different parts of the sac were thus acted upon, the pin being left in contact with each of these places for ten minutes. At the expiration of two hours the pin was removed, pressure over the puncture being maintained for about five minutes. Fifteen minutes subsequently the pressure on the common iliac was slowly removed. Dr. Macewen then thought the wall of the sac was already firmer, but his assistants and the patient could see no change. Twelve hours later, the walls

felt firmer, and there was no doubt of the improvement. This thickening of the coats became greater daily, the solidification occurring five days after the insertion of the pin, the aneurismal sac then being converted into a solid ball, which still moved with the arterial impulse, but there was no eccentric pulsation. Contraction and solidification continued from this time, the patient returning to his work, fully restored, eight weeks later.

About a year subsequently to the obliteration of the aneurism he died from carcinoma of the tongue. The autopsy showed a small aneurism of the left femoral, which had been observed at the time of the operations, and a large one of the aortic arch which had been suspected, while all the larger vessels were found to be subject to calcareous degeneration. The obliterated right femoral aneurism, instead of measuring five inches in length and breadth, as it did before the operation, now measured but two inches in length and three quarters of an inch in breadth. It presents a hard solid mass which, on section, is seen to be composed of dense vascularized fibrous tissue. Histologically, it presents dense connective tissue interspersed with numerous blood vessels.

3. The third case was an aneurism of the upper part of the abdominal aorta, which presented a marked prominence in front, being somewhat circular in form and measuring three inches in circumference. By inflating the stomach and intestines with gas, it was discovered that they lay below the tumor, a free surface of which presented externally. The patient on three occasions was subjected to irritation of the internal coat of the sac, after each of which there was a notable thickening of the wall; the force of the pulsation diminished at the part and the pain and discomfort greatly lessened. As the tumor lessened, the stomach began to overlap it in front. In a month the sac had receded to such an extent that it could not clearly be made out other than as a hard mass, heaving with the aortic pulsations. At this period the patient insisted upon returning to his work, although the cure was not yet complete, and his move was regarded with great apprehension by the operator. He continued to work as an engine driver, and was in seeming good health when seen two years and a half later.

4. The fourth case was an intra-thoracic aneurism of the subclavian, accompanied by great swelling, pain, numbness and loss of power in the left arm. The tumor projected above the clavicle into the neck. The upper wall of the aneurism was very thin. An aseptic pin, five and one half inches in length, was introduced, and by it the form and dimensions of the sac were ascertained. It was found to be about four inches high and three inches wide. The pin was then permitted to remain in the cavity for about nine hours, its extremity being frequently changed from one part of the sac to another, its point on each occasion being left free to move over the surface of the sac as the force of the stream of blood in the interior might direct. This was repeated four times, with an interval of one to two weeks between them, a gradual thickening of the walls of the aneurism ensuing. This was marked, not only by the sensation communicated to the finger externally, but by the fact that on each occasion, upon attempting to introduce the pin, greater difficulty was experienced in penetrating the coats of the vessel; while, at the outset, a pin of very fine calibre was readily introduced through the sac wall, it required a much stouter and more rigid one to penetrate the sac during the last insertions.

The improvement consequent upon these insertions was so marked that they were discontinued for four months, during which time there was diminution in the oedematous swelling of the arm and subsidence of the pain. Subsequently there was much thickening in the aneurism and great diminution in the pulsation; it was not so near the surface, but still there was a doubt as to whether it was not eccentric; it might have been that the tumor was pushed upward with each aortic wave, and being dome-shaped, conveyed the sensation of an eccentric pulsation. On five subsequent occasions a pin was introduced, with the object of hastening the consolidation; on each of these, it was difficult to say what the internal dimensions of the cavity were, and during the last two of them it was doubtful if it entered any cavity; the walls were so thick that the pin could not be made to move to and fro as it formerly did; certainly, it never reached the opposite wall of the aneurism, and it was, therefore, questionable whether good was derived from its use. Accordingly, the treatment was discontinued.

From this time the tumor began to decrease in size, the œdema of the arm gradually disappeared, and the numbness and the tingling sensation soon followed. The pulsation of the radial also gradually diminished until they finally ceased. The power of the arm was gradually restored, and eight months after the first puncture the patient was in excellent health, with a hardness about a third the size of the original tumor, which could be felt by slipping the fingers somewhat behind the clavicle.

Dr. Macewen recapitulates as follows: Here are four cases of aneurism, one involving the innominate, one the left subclavian, one the abdominal aorta, and one the upper part of the femoral implicating the external iliac. Two of these have been absolutely cured by the induction of white thrombi within the sac. One was so greatly relieved that he was able to resume his work as a locomotive engine driver, and to continue it for at least two and a half years thereafter. One died after two months' treatment from asphyxia when the aneurism was two-thirds healed, and when complete consolidation was within a few weeks of consummation. In the large aneurism of the femoral and iliac the circulation within the vessel was arrested for two hours, during which time treatment was performed on the sac wall; consolidation resulted in five days, and he was cured in a month. The aortic and innominate aneurism was a month under treatment, and had pins inserted on seven occasions. The formation of thrombi occurred rapidly, and was more extensive than was known during the patient's life. The aneurism of the abdominal aorta was a month under treatment, but it was not cured, the consolidation being incomplete. The aneurism of the left subclavian had pins introduced on nine occasions, though it is questionable whether the last pin produced any effect, or whether they were needed; consolidation occurred within nine months, and the cure was completed within a year.

None of these patients had anaesthetics administered, and they suffered comparatively little pain during the operation. The slowness of the occlusion in the last case, though disadvantageous in some respects, had certain advantages valuable in the presence of advanced arterial disease. It enabled the collateral circulation to become fully

established in a very gradual manner before complete occlusion of the sac had occurred, and thus saved the collateral vessels from sudden dilatation by increased blood pressure. It protected the heart and blood vessels on the proximal side of the aneurism from the sudden strain which would otherwise have been thrown on them by ligature of the vessels or by sudden occlusion of the aneurism. Though the completion of the cure takes long in certain instances, the aneurism is not left unprotected during that period, as its coats have been lined by white thrombi, forming a firm barrier against further aneurismal extension.

It is probable that, besides acting locally on the aneurism, in addition attention to the general state of the individual may facilitate the formation of white thrombi. By placing him in good hygienic surroundings, by limiting or regulating his diet so as to produce an effect upon the leukocytes of the blood, by the administration of drugs and by keeping the patient in a state of rest—any or all of these may have an effect in hastening the desired result; these are some of the points still to be worked out. It is well, however, that the fact should be established that white thrombi may be induced simply by direct local action, without any aid from other directions. No doubt some cases will be found more suitable than others for this form of treatment; in some, the white thrombi will form more readily, in some more slowly—future experience will decide. Dr. Macewen trusts that this form of treatment will not be indiscriminately employed upon every case of enlarged aneurism, especially upon those which are beyond hope, otherwise the method will become discredited. The very simplicity of the treatment, the facility with which it may be carried out, without even the use of an anæsthetic, and with a comparatively limited anatomical knowledge, makes this word of caution necessary. The cases of uncomplicated aneurism must be few in which the introduction of an aseptic steel pin into the sac would be productive of harm; disastrous results would easily follow the introduction of a pin carrying septic matter with it.

The author is not irretrievably committed to his methods of performing the operation. The main point is the recognition of the fact that

every aneurism contains within itself a potential cure. The method of calling it forth is but a secondary matter.

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KRECKE ON THE SURGICAL TREATMENT OF CIRCUMSCRIBED
AND GENERAL PERITONITIS STARTING FROM THE
VERMIFORM APPENDIX.¹

The affection of the appendix, leading to peritonitis, is its perforation. This produces diverse phenomena according as it occurs, suddenly or gradually. When it develops very slowly the neighboring peritoneal surfaces have sufficient time to unite, and by the great tendency to such adhesions only a circumscribed peritonitis then results. When, however, the perforation is sudden and the material passes into the free abdominal cavity, general peritonitis is the unavoidable sequence. But as the various types of peritonitis are more carefully distinguished it is found that that from perforation of the appendix differs from that following perforation of other portions of the intestine. Almost without exception the patients have previously been in the enjoyment of perfect health. As their physical powers are unimpaired they are in better condition to tolerate operative procedures than if exhausted by long sickness. A further peculiarity is due to the anatomical relations of the appendix. When there is a perforation in any part of the small intestine the continuous peristaltic suffices to distribute the intestinal contents over the whole peritoneum. The vermiform can not make such large excursions as a loop of the small intestine, or even as the stomach, and hence at first the extruded material infects only adjacent parts of the peritoneum. Besides it is evident that from this little appendix there can never come as much infectious material as from the gut itself. The fact that at no other point in the abdomen does circumscribed peritonitis so frequently occur as just here agrees with this view. The until recently accepted treatment of vermiform perforation with opiates was based on these naturally favoring conditions.

¹Dr. Krecke, Assistant at the Erlangen Clinic, in *Deutsche Zeitschrift f. Chirurgie*, 1890, bd., 39; hist. 4 and 5.